



*Developing Response to
Intervention Systems in
Secondary Mathematics:
Lessons Learned and Roads Not Yet Traveled*

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Session Goals

- ▶ SOME components of an RTI system
 - Evidence-based core curriculum
 - Screening assessment tools
 - Supplemental interventions
 - Progress monitoring tools
- ▶ Facilitate discussion among participants regarding:
 - Experiences with RTI models in mathematics at the secondary level
 - Roadblocks encountered
 - Success stories
 - Future directions for research and development



Components of an
RTI System



Evidence-based Core Curriculum

- ▶ Sources of evidence
 - **What Works Clearinghouse**
US Department of Education
<http://ies.ed.gov/ncee/wwc/>
 - Best Evidence Encyclopedia
Johns Hopkins University
<http://www.bestevidence.org/>
- ▶ More data available for middle school
- ▶ Criteria for inclusion of studies vary, causing different results across sources

Screening Assessment Tools

- ▶ State test data from the previous school year
- ▶ Progress monitoring assessments used as screeners
- ▶ Commercial screening tests
- ▶ Locally-developed options

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Research Highlight

- ▶ Foegen & Lind (2009) RIPM middle school mathematics technical report (#21)
 - Single administration of 6 progress monitoring measures
 - District administered 3 screening tools
 - Outcome measure: high stakes test (ITBS)
- ▶ Results indicated strongest relations with were obtained with district-identified screening tools
- ▶ Of the progress monitoring measures, only the Concepts and Applications measure demonstrated similarly strong relations

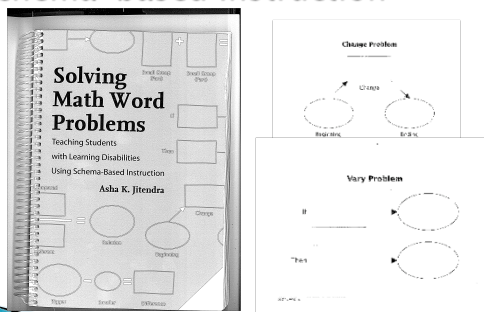
Supplemental Interventions

- ▶ Computer-assisted instruction
 - Plato
 - Expert Mathematician
 - Cognitive Tutor
- ▶ Research-based interventions
 - Primarily from the special education literature
 - Schema-based instruction (Jitendra et al.)
 - Concrete-representational-abstract teaching sequences (Susan Miller, Witzel, Maccini)
- ▶ LIMITED options for secondary mathematics!

Research Highlight

- ▶ Asha Jitendra at the University of Minnesota has developed instructional programs using schema theory to help students understand the underlying concepts in mathematics word problems
- ▶ Studies in small groups and general education classes have supported the efficacy of this approach for improving the word problem solving of students with or at risk for disabilities

Schema-based Instruction







Estimation				
Estimation Probe 1				
A large pizza has 16 slices. 5 kids will share the pizza. About how many slices will each kid get?	22 x 59 is about	It takes 2 1/2 yards of fabric to make a costume for the play. Mona has 11 yards of fabric. About how many costumes can she make?	8/355 is about	The gym shoes cost \$82. They are on sale for 25% off. About how much will you save?
0.3 3 30	12 120 1,200	0.4 4 40	0.7 7 70	\$20 \$200 \$2,000
4 x 9.3 is about	Edward makes \$4 per hour doing odd jobs. If he works 11 hours, about how much will he earn?	0.45 - 0.14 is about	Luis wants to buy 6 new books. If each one costs \$12, about how much will Luis pay for the 6?	8/0.19 is about
0.36 3.6 36	\$4 \$40 \$400	0.3 3 30	\$0.60 \$6 \$60	0.02 0.2 2
Christine's car went 300 miles on 11 gallons of gas. About how many miles per gallon did the car get?	97.7 - 21.4 is about	There are 30 students in the class. Each student paid \$3.50 for the bus. About how much money do they have for a bus?	73 - 18 is about	Joel earns \$4.25 per hour stacking shelves at the grocery store. About how much will he earn in 20 hours?
27 270 2,700	0.8 8 80	\$10 \$100 \$1,000	5 50 500	\$0.80 \$8 \$80
78 - 17 is about	The car's gas tank holds 14 gallons. You just pumped in 11.75 gallons to make the tank full. About how many gallons were already in the tank?	219 - 876 is about	For her birthday, Sue received \$19 from Grandpa and \$12 from Aunt Sue. About how much did she receive from these two people?	16/773 is about
10 100 1,000	2 20 200	10 100 1,000	\$5 \$50 \$500	1 10 100

Complex Quantity Discrimination

Complex Quantity Discrimination Form A

$50 \div 9 \square 9 \div 50$	$18 \square 2 \div 9$	$62 \square 76$	$-2 \square .03$
$56 \square 7 \div 8$	$.5 \square .2$	$50 \div 7 \square 5 \div 70$	$15 \square 15 \div 3$
$32 \div 8 \square 32 \div 5$	$80 \div 2 \square 20 \div 8$	$60 \div 4 \square 8 \div 40$	$10 \square 10 \div 7$
$70 \div 5 \square 72 \div 3$	$20 \div 8 \square 20 \div 9$	$80 \square 80$	$75 \square 70 \div 5$
$51 \square 25$	$.4 \square .2$	$10 \div 2 \square 12 \div 2$	$\frac{1}{2} \square \frac{1}{2}$
$75 \div 4 \square 71 \div 1$	$50 \square 20 \div 1$	$20 \square 20$	$24 \square 2 \div 6$
$\frac{1}{2} \square \frac{1}{2}$	$90 \square 95 \div 1$	$90 \square 90 \div 2$	$20 \square 25 \div 5$
$9 \square 90$	$40 \div 8 \square 40 \div 9$	$70 \div 80 \square 70 \div 8$	$80 \div 8 \square 40 \div 8$
$2 \div 20 \square 3 \div 2$	$15 \square 15 \div 5$	$70 \square 7 \div 4$	$60 \square 10 \div 5$
$2 \div 80 \square 1 \div 4$	$.4 \square .09$	$30 \square 24 \div 4$	$80 \div 5 \square 96 \div 4$
$2 \square 30$	$40 \div 10 \square 80 \div 5$	$10 \div 5 \square 5 \div 10$	$60 \div 4 \square 30 \div 4$

Project KUPN, Iowa State University

Missing Number

Missing Number Form A

37, 40, 43, ____	11, 22, 44, ____	43, ____ 45, 46	12, ____ 24, 30
30, 35, 40, ____	32, 28, ____ 20	21, 16, 11, ____	50, 60, ____ 80
48, 40, 32, ____	25, 20, 15, ____	24, ____ 12, 8	35, ____ 37, 38
18, 16, 14, ____	19, 20, 21, ____	6, ____ 12, 15	8, 16, 32, ____
80, 76, ____ 77	56, 57, ____ 59	88, 44, 22, ____	27, ____ 21, 18
24, 12, 6, ____	36, ____ 54, 63	14, 16, 18, ____	56, 40, ____ 35
70, 60, ____ 40	14, 21, ____ 35	48, 48, 41, ____	28, 25, 22, ____
10, 9, 8, ____	43, 45, 47, ____	47, 57, 67, ____	38, 42, 46, ____
2, 4, 8, ____	28, ____ 26, 25	7, 12, 17, ____	80, 40, 20, ____
40, 48, 56, ____	12, 16, ____ 24	85, ____ 63, 54	48, 36, 28, ____
17, 15, 13, ____	56, 28, 14, ____	13, 26, 52, ____	65, 64, ____ 62

Project KUPN, Iowa State University

Progress Monitoring Measures for PreAlgebra or Algebra 1

Basic Skills

Page 1	
Solve: $4x + 15 = 3$	Solve: $10 = 8 + x$
Evaluate: $12 + 5(3) + 7$	Simplify: $9 + 4(-2) + 7(2)$
Simplify: $2x + 4 + 3x + 5$	Simplify: $5(5 - 3) - 4$
Solve: $12 - x = 4$	Solve: $4x + 3 = 10$
Evaluate: $4(3) + 7$	Evaluate: $8 + 4(-2) - 4$
Simplify: $4 + 3 - 15$	Simplify: $3 + 4(5 - 3)$
Solve: $2 = \frac{12}{x + 10}$	Solve: $1.5(-12) = 36$
Simplify: $7 - 3(-2)$	Simplify: $4 + 10 + 5(5 - 1)$
Evaluate: $-5 + (-4) - 1$	Simplify: $(x + 2) - 4x$
Solve: $4(5 + x) = 9$	Solve: $x + 4 = 7$
Simplify: $3(5 - 1) + 4 + 5x$	Simplify: $-5x + 3(x + 5)$
Evaluate: $8x - 9(5x + 2)$	Evaluate: $9 + (-3) - 8$
Solve: $3(4 - 1) + 10 = 7 + 10x$	Solve: $\frac{12}{x} = 48$
Evaluate: $4 - 12 + 8$	Simplify: $x^2 - 4x + 3$
Simplify: $2(4 - 3) - 5(4 + 1)$	Simplify: $5(7 - 2) - 3x$

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Algebra Foundations

Page 1				
Find the ordered pair for each point: $A(\quad , \quad)$ $B(\quad , \quad)$	Fill in the empty box: x $3x$ 6 18 7 21 8 9 27	Fill in the empty box: m $4m + 7$ -1 3 -2 -3 -5 -4 -9	Fill in the empty box: b -2 -5 0 -3 3 0 5 2	
If $y > 9$, two possible values for y are _____ and _____	Evaluate: $5 + 4 - 6$	Simplify: $2x + 3y + 4z$	Solve: $x + 3 = 8$ $x =$	What is the slope? What is the y-intercept?
Evaluate $4b + 2$ when $b = 1$ $b = 3$	Write the expression for this phrase: 6 less than a number	Evaluate: $(-2) + (-4)$	Graph the expression $m > -5$ $\bullet \text{---} -4 \text{---} -2 \text{---} 0 \text{---} 2 \text{---} 4 \text{---} 6$	
Write a word phrase for this expression: $m + 9$	Evaluate: $4 + (5 + 3) - 2^2$	Evaluate: $(-2)^2$	Write the expression for this phrase: 5 multiplied by a number	
Evaluate $2x + 4y$ when $x = 2$ and $y = 3$	Write a word phrase for this expression: $10b - 7$	Evaluate $4g - 4$ when $g = 2$ $g = 2$ $g = -2$	Simplify: $6 - 2(b - 4)$	

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Translations

A	B	C	D																																																
$y = x$	$y = 2x - 1$	$y = 1.5$	$y = -x + 1$																																																
<table border="1"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr><td>-2</td><td>-2</td></tr> <tr><td>-1</td><td>-1</td></tr> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td></tr> </tbody> </table>	x	y	-2	-2	-1	-1	0	0	1	1	2	2	<table border="1"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr><td>-2</td><td>-5</td></tr> <tr><td>-1</td><td>-3</td></tr> <tr><td>0</td><td>-1</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>3</td></tr> </tbody> </table>	x	y	-2	-5	-1	-3	0	-1	1	1	2	3	<table border="1"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr><td>-2</td><td>1.5</td></tr> <tr><td>-1</td><td>1.5</td></tr> <tr><td>0</td><td>1.5</td></tr> <tr><td>1</td><td>1.5</td></tr> <tr><td>2</td><td>1.5</td></tr> </tbody> </table>	x	y	-2	1.5	-1	1.5	0	1.5	1	1.5	2	1.5	<table border="1"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr><td>-2</td><td>3</td></tr> <tr><td>-1</td><td>2</td></tr> <tr><td>0</td><td>1</td></tr> <tr><td>1</td><td>0</td></tr> <tr><td>2</td><td>-1</td></tr> </tbody> </table>	x	y	-2	3	-1	2	0	1	1	0	2	-1
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Mark needs to find half the width of pieces of pipe he is cutting to make a soccer goal. The width of the pipe is 3 inches. He wrote this equation to show the relationship between the length and the width of the pieces he will cut.



Every day that Cindy waters the garden, she earns a dollar. She wrote this equation to show the relationship between the number of days she waters the garden and the number of dollars she will earn.

Joe has one dollar in his wallet. He wrote this equation to show the relationship between the number of dollars he borrows from his friends for lunch and the total amount of money he has or owes.

The class earns \$2 for each magazine subscription sold in the fund-raiser. A \$1 fee per student is charged for a processing fee. Cindy wrote this equation to show the relationship between the number of magazines sold and the profit.

The floodwaters are receding at a rate of 1 foot per day. The river is currently at 1 foot above flood stage. Tom wrote this equation to show the relationship between the number of days and the height of the river compared to flood stage.

Content Analysis

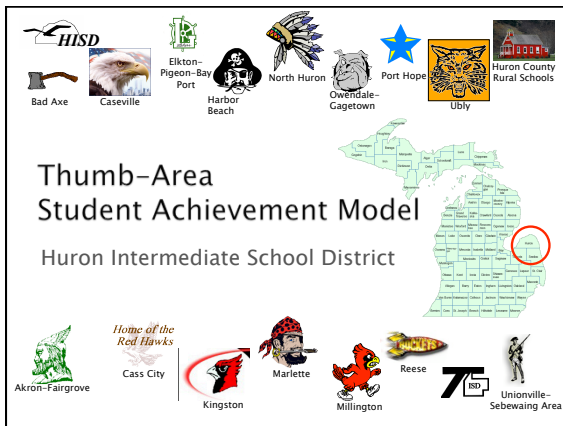
Page 7 (Item 11)		Page 1	
<p>Solve: $3x + 4 = 19$ $x =$</p> <p>a) 8 b) 22 c) 15 d) 5</p>	<p>Evaluate $a^2 - b + 2$ when $a = 4$ and $b = 6$</p> <p>a) 1 b) 5 c) 10 d) 13</p>	<p>Which line on the graph is $x + 2y = 7$?</p>  <p>a) Line A b) Line B c) Line C d) Line D</p>	<p>Simplify: $5(m + 2) + 3(m - 1)$</p> <p>a) $5m + 4$ b) $5m + 1$ c) $6m + 8$ d) $6m - 6$</p>
<p>Evaluate the expression: 4^{-2}</p> <p>a) -16 b) $\frac{1}{16}$ c) $\frac{1}{8}$ d) -8</p>	<p>Solve the linear system: $x - y = 4$ $x + 2y = 19$</p> <p>a) (-1, -5) b) (5, 8) c) (-2, 10) d) (0, 5)</p>	<p>This graph shows the solution for which equation?</p>  <p>a) $x > -3$ b) $2x - 6 = 0$ c) $-3x > 9$ d) $3x \geq 9$</p>	<p>Write the equation in slope- intercept form if $m = -\frac{1}{2}$ and $b = 3$</p> <p>a) $y = 2x + 3$ b) $y = 3x + \frac{1}{2}$ c) $x = \frac{1}{2}y - 3$ d) $y = \frac{1}{2}x + 3$</p>

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**Experiences with RTI in
Secondary Mathematics**

Huron Intermediate School District

- ▶ Bad Axe, Michigan
- ▶ Jenni Trusock, Mathematics Instructional Consultant
- ▶ Middle school through Algebra 1
- ▶ Student Achievement Model



The SAM Process

- ▶ Use a three-tier model to catch students who “fall through the cracks”
- ▶ Focus on prevention
- ▶ Use research-based strategies and RTI
- ▶ Use student data in team-based decision making

Student Achievement Model

an approach to continuous improvement

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School-wide Support Systems for Student Success

Intensive Intervention

T3: Individualized, functional assessment, highly specific

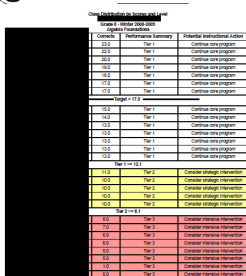
Strategic Intervention

T2: Supplemental, some students, reduce risk

Universal Intervention

T1: Core Instruction for all students, preventive

SAM Math Measures



AIMSweb for K-8:


- Computation probes for Grades 1-8.
- Early Numeracy skill probes for Grades K-1.

Project AAIMS from Iowa State University for Grades 6-8 and Algebra 1:

- Basic Skills
- Foundations
- Content Analysis

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High School Mathematics in Michigan



4 credits of math required to graduate - including Algebra 1, Geometry, and Algebra 2

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AAIMS Measures Used in SAM

	Grade 6			Grade 7			Grade 8 (incl. Alg. 1)			Algebra 1 (incl. Gr. 8)		
	F	W	S	F	W	S	F	W	S	F	W	S
Benchmark Screening Measure												
AIMSweb (M-CBM Gr. 6, M-CBM2 Gr. 7-8)												
Algebra Basic Skills	Opt.											
Algebra Foundations												
Content Analysis												

Shaded cells indicate grades at which students are assessed.

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Setting Targets



- ▶ Using local norms:
 - Below 10th percentile is Tier 3
 - 11th to 25th percentile is Tier 2
 - 26th to 49th percentile is Tier 1 but below target
 - 50th percentile is Target

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Skill-based Intervention Groups

- ▶ Computation
- ▶ General/broad deficiencies in mathematics
- ▶ Fractions
- ▶ Decimals
- ▶ Percents
- ▶ Equivalent fractions
- ▶ Fluency
- ▶ Work habits

Your Experiences with RTI in Secondary Mathematics



Roadblocks



Success Stories



Future Directions
for Research & Development

